Complete Summary

GUIDELINE TITLE

Removal of the endotracheal tube.

BIBLIOGRAPHIC SOURCE(S)

American Association for Respiratory Care (AARC). Removal of the endotracheal tube. Respir Care 1999 Jan;44(1):85-90. [78 references]

COMPLETE SUMMARY CONTENT

SCOPE

DISEASE/CONDITION(S)

Pulmonary disease

GUIDELINE CATEGORY

Evaluation
Treatment

CLINICAL SPECIALTY

Pulmonary Medicine

INTENDED USERS

Respiratory Care Practitioners

GUIDELINE OBJECTIVE(S)

- To improve the consistency and appropriateness of respiratory care and serve as a guide for education and research.

- To provide clinical practice guidelines on removal of the endotracheal tube

TARGET POPULATION

Adult, pediatric and newborn patients with endotracheal tubes

INTERVENTIONS AND PRACTICES CONSIDERED

Removal of the endotracheal tube (extubation)

MAJOR OUTCOMES CONSIDERED

- Clinical outcome as assessed by physical examination, auscultation, invasive and noninvasive measurements of arterial blood gas values, and chest radiography
- Extubation complications and the need for reintubation

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

Not stated

NUMBER OF SOURCE DOCUMENTS

Not stated

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Not stated

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

Not applicable

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Not stated

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

External Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Consultants to the Working Group may review the initial draft of the guideline. After completion by the Working group, the draft is reviewed by the entire Steering Committee and then by a Review Panel, persons engaged in all facets of the delivery of respiratory care who have volunteered to review drafts of the Guidelines before publication.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

Description/Definition:
To ensure patient safety, the patient with a temporary, artificial translaryngeal airway should have the device removed at the earliest appropriate time. Occasionally, acute airway obstruction of the artificial airway due to mucus or mechanical deformation mandates immediate removal of the artificial airway. (This guideline pertains to the decision processes surrounding the removal of an artificial translaryngeal airway, and the procedure referred to as extubation.)

- Prolonged translaryngeal intubation is associated with many complications including but not limited to sinusitis, vocal cord injury, laryngeal injury, laryngeal stenosis, tracheal injury, hemoptysis, and pulmonary infection.
- Extubation may result in upper airway obstruction from laryngospasm, laryngeal edema, or supraglottic obstruction; pulmonary edema; pulmonary aspiration syndrome; or impaired respiratory gas exchange.

Settings:
The endotracheal tube should be removed in an environment in which the patient can be physiologically monitored and in which emergency equipment and appropriately trained health care providers with airway management skills are immediately available.

Indications/Objectives:
When the airway control afforded by the endotracheal tube is deemed to be no

longer necessary for the continued care of the patient, the tube should be removed. In general, the patient should be capable of maintaining a patent airway and adequate spontaneous ventilation and should not require high levels of positive airway pressure to maintain normal arterial blood oxygenation.

- Patients in whom further medical care is considered (and explicitly declared) futile may have the endotracheal tube removed despite continuing indications for the artificial airway.
- Acute artificial airway obstruction mandates immediate endotracheal tube removal if the obstruction cannot be cleared rapidly. Reintubation or other appropriate techniques for reestablishing the airway must be used to maintain effective gas exchange (ie, surgical airway management).

Contraindications:
There are no absolute contraindications to extubation; however, some patients will require reintubation, positive pressure ventilation, continuous positive airway pressure, noninvasive ventilation, or high inspired oxygen fraction to maintain acceptable gas exchange after extubation. Airway protective reflexes are usually depressed immediately following and for some time after extubation and, therefore, measures to prevent aspiration should be considered.

Limitations of Methodology/Validation of Results
Patients may need reintubation immediately or after some interval due to inappropriate extubation, progression of underlying disease, or development of a new disorder. A trial of extubation may be used in some marginal patients with the expectation that the need for reintubation is likely.

The need to reinsert an artificial airway following extubation is not necessarily an indication of poor practice. Inadequate airway maintenance and failure of reintubation may be an indication of poor practice.

The failure and complication rates of extubation can be used as quality monitors.

Assessment of Need
The endotracheal tube should be removed as soon as the patient no longer needs an artificial airway. Patients should be capable of adequate spontaneous ventilation and should not require high levels of positive airway pressure or inspired oxygen to maintain adequate arterial blood oxygenation. (Experience suggests PEEP less than or equal to 10 cm H2Oand FIO2 less than or equalto 0.40.)

- Patients receiving an artificial airway to facilitate treatment of respiratory failure should be considered for extubation when they have met traditional weaning criteria. Examples of weaning criteria include but are not limited to
    1. the capacity to maintain adequate arterial partial pressure of oxygen on inspired oxygen fractions provided with simple oxygen devices and with low levels of positive airway pressure;
    2. the capacity to maintain appropriate pH and arterial partial pressure of carbon dioxide during spontaneous ventilation;
    3. adequate respiratory muscle strength;
    4. maximum negative inspiratory pressure > 30 cm H2O;
    5. vital capacity greater than 10 mL/kg ideal body weight;

6. pressure measured across the diaphragm during spontaneous ventilation less than 15% of maximum;
7. spontaneous exhaled minute ventilation < 10 L/min.
8. in adults, respiratory rate < 35 during spontaneous breathing; in infants and children, acceptable rate decreases with age and can be predicted and measured with good repeatability when determined by stethoscope.
9. in adults, a rapid shallow breathing index (RSB, respiratory rate-to-tidal-volume ratio) of less than or equal to 98-130; in infants and children, neither a modified CROP index (derived from compliance, resistance, oxygenation, and ventilating pressure) nor a modified RSB has been shown to be a superior discriminator between successful and unsuccessful extubation.)
10. thoracic compliance > 25 mL/cm H2O;
11. work of breathing < 0.8 J/L;
12. oxygen cost of breathing < 15% total;
13. dead-space-to-tidal-volume ratio < 0.6;
14. absolute tracheal pressure in the first 0.1 second of occlusion < 6 cm H2O; (This measurement is primarily a research tool.)
15. maximum voluntary ventilation > twice resting minute ventilation.

- In addition to treatment of respiratory failure, artificial airways are sometimes placed for airway protection. Resolution of the need for airway protection may be assessed by but is not limited to
    1. normal consciousness,
    2. adequate airway protective reflexes,
    3. easily managed secretions.
- In addition to resolution of the processes requiring the insertion of an artificial airway, issues that should be considered in all patients prior to extubation are
    1. no immediate need for reintubation anticipated;
    2. no previously identified difficulties with intubation;
    3. presence of gas leak around the deflated cuff with positive pressure breaths;
    4. evidence of stable, adequate hemodynamic function;
    5. evidence of stable nonrespiratory functions;
    6. electrolyte values within normal range.

Assessment of Outcomes

Removal of the endotracheal tube should be followed by adequate spontaneous ventilation through the natural airway, adequate oxygenation, and no need for re-intubation.

- Clinical outcome may be assessed by physical examination, auscultation, invasive and noninvasive measurements of arterial blood gas values, and chest radiography.
- Quality of the procedure can be systematically assessed by monitoring extubation complications and the need for reintubation.

Resources

- Equipment:
    1. Oxygen source
    2. Devices to deliver oxygen-enriched gas mixtures

3. High-volume suction source
4. Pharyngeal and tracheal suction catheters
5. Self-inflating or non-self-inflating manual ventilation system
6. Oral and pharyngeal airways
7. Endotracheal tubes of various sizes
8. Translaryngeal intubation equipment (laryngoscope blades, handles, batteries, stylettes)
9. Equipment for establishing an emergency surgical airway (scalpel, lidocaine with epinephrine, appropriately sized endotracheal or tracheostomy tubes)
10. Pulse oximeter
11. Supplies for arterial puncture and blood gas analysis.

- Personnel
  1. Level-II personnel, credentialed and/or licensed health care personnel with documented knowledge and demonstrated skills specific to patient assessment and airway management, should determine the appropriateness of extubation, be available to assess success, and begin appropriate interventions should immediate complications occur. Personnel skilled in endotracheal intubation and the insertion of invasive airways should be immediately available whenever extubation is performed.
  2. Level-I personnel, credentialed and/or licensed health care personnel with documented knowledge and demonstrated skill in providing oxygen administration devices and suctioning the airway, may provide support to Level-II personnel during the extubation procedure.
  3. In the event of acute obstruction of the artificial airway, anyone with airway maintenance skills may remove the endotracheal tube to save the patient's life.

Monitoring

The success of removal of the endotracheal tube can be monitored by examining the frequency of reintubation and frequency of complications. When a patient experiences an unplanned self-extubation and does not require reintubation, this suggests that planned extubation should have been considered sooner.

Frequency

The timing of extubation is determined by improvement in the patient's condition that mandated an artificial airway. Acute, artificial airway obstruction may occur at any time and must be recognized and treated immediately.

Infection Control

Caregivers should exercise Standard Precautions for all patients, follow CDC recommendations for control of exposure to tuberculosis and droplet nuclei, and, in addition, institute appropriate precautions empirically for airborne, droplet, and contact agents pending confirmation of diagnosis in patients suspected of having serious infections.

CLINICAL ALGORITHM(S)

None provided

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

Not specifically stated for each recommendation: The guideline is developed from a thorough review of the literature, surveys of current practice, and the expertise of the members of the working group.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

- Appropriate management of temporary, artificial translaryngeal airways
- Timely and safe removal of the endotracheal tube when the airway control afforded by the endotracheal tube is deemed to be no longer necessary for the continued care of the patient

POTENTIAL HARMS

- Hypoxemia after extubation may result from but is not limited to
    1. failure to deliver adequate inspired oxygen fraction through the natural upper airway;
    2. acute upper airway obstruction;
    3. development of postobstruction pulmonary edema;
    4. bronchospasm;
    5. development of atelectasis, or lung collapse;
    6. pulmonary aspiration;
    7. hypoventilation
- Hypercapnia after extubation may be caused by but is not limited to:
    1. upper airway obstruction resulting from edema of the trachea, vocal cords, or larynx;
    2. respiratory muscle weakness;
    3. excessive work of breathing;
    4. bronchospasm.
- Death may occur when medical futility is the reason for removing the endotracheal tube.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better
Living with Illness

IOM DOMAIN

Effectiveness
Safety

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

American Association for Respiratory Care (AARC). Removal of the endotracheal tube. Respir Care 1999 Jan;44(1):85-90. [78 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1999 Jan

GUIDELINE DEVELOPER(S)

American Association for Respiratory Care - Professional Association

SOURCE(S) OF FUNDING

American Association for Respiratory Care (AARC)

GUIDELINE COMMITTEE

Endotracheal Tube Removal Working Group

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Working Group Members: Charles G. Durbin Jr. MD, Chairman; Robert S. Campbell RRT; Richard D. Branson RRT.

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

This is the current release of the guideline.

According to the guideline developer, this version has been reviewed within the last five years and is considered current.

An update is not in progress at this time.

GUIDELINE AVAILABILITY

Electronic copies: Available from the American Association for Respiratory Care (AARC) Web site.

Print copies: Available from AARC, CPG Desk, 11030 Ables Ln, Dallas, TX 75229-4593.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- The AARC Clinical Practice Guidelines. Respir Care 1996;41(7):647-53.

Print copies: Available from the American Association for Respiratory Care (AARC), CPG Desk, 11030 Ables Ln, Dallas, TX 75229-4593; Web site: www.aarc.org.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on April 25, 1999. The information was verified by the guideline developer on April 25, 1999.

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